IS 11863 (1986): Tolerances for worm gears [PGD 31: Bolts, Nuts and Fasteners Accessories]

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UDC 621·833·38 : 621·753·1

Indian Standard (Reaffirmed 2005)

TOLERANCES FOR WORM GEARS

Gears Sectional Committee, EDC 59; Worm Gears Subcommittee, EDC 59 : 1 [Ref : Doc : EDC 59 (4193)]

1. Scope — Covers the tolerances for machine cut worm gears.

2. Terminology — For the purpose of this standard, the definitions and notations given in IS : 5267-1969 'Glossary of terms for worm gears', and IS : 2467-1963 'Notation for tooth gearing' shall apply.

3. Accuracy Classes — The worm gears are classified into four accuracy classes A, B, C and D. The applications of these accuracy classes are as follows:

Accuracy Class	*Application*
A	Master gears
B	Precision gears
C	Semi-precision gears
D	Coarse gears

4. Maximum Permissible Errors

4.1 *Worms*

4.1.1 *Lead error* — The permissible departure from the designed axial spacing of any two corresponding points on sections of the worm threads in a plane containing the axis shall be as given below:

Class	*Tolerance in Micrometres*
A	$\pm (5 + 1{\cdot}6 \sqrt{pz})$
B	$\pm (8 + 2{\cdot}5 \sqrt{pz})$
C	$\pm (13 + 4 \sqrt{pz})$
D	$\pm (20 + 6 \sqrt{pz})$

where

pz = designed axial distance in mm, of the two points concerned, which must lie at the same radial distance from the axis.

Adopted 9 October 1986 | | Gr 2

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4.1.2 *Circular pitch error (indexing error)* — The errors in circumferential spacing of the adjacent threads at the pitch circle in any transverse plane for a multi-start worm shall not exceed the following:

Class	*Tolerance in Micrometres*
A	$\pm\left(5 + 1{\cdot}5\sqrt{\frac{d_1}{z_1}}\right)$
B	$\pm\left(8 + 2{\cdot}4\sqrt{\frac{d_1}{z_1}}\right)$
C	$\pm\left(13 + 3{\cdot}8\sqrt{\frac{d_1}{z_1}}\right)$
D	$\pm\left(20 + 6\sqrt{\frac{d_1}{z_1}}\right)$

where

d_1 = reference diameter of worm, in millimetres; and

z_1 = number of starts in worm.

4.1.3 *Thread thickness error* — The departure from the normal designed thread thickness shall not exceed the following values:

Class	*Tolerance in Micrometres*
A	$^{+\ 0}_{-\ (0{\cdot}8p_x + 20)}$
B	$^{+\ 0}_{-\ (1{\cdot}1p_x + 33)}$
C	$^{+\ 0}_{-\ (2\ p_x + 51)}$
D	$^{+\ 0}_{-\ (3{\cdot}2p_x + 81)}$

where

p_x = axial pitch of worm, in millimetres.

Note — Not applicable when lead angle exceeds 45°.

4.1.4 *Profile error* — The error measured by the departure of the thread flank from the base tangent that coincides with the flank at mid-depth is given below:

Class	*Tolerance in Micrometres*
A	$^{+\ 0}_{-\ (0{\cdot}25\ m + 3)}$
B	$^{+\ 0}_{-\ (0{\cdot}4\ m + 4)}$
C	$^{+\ 0}_{-\ (m + 6)}$
D	$^{+\ 0}_{-\ (2{\cdot}5\ m + 15)}$

where

m = axial module of threads, in millimetres.

Note 1 — The design profile represents the maximum metal condition.

Note 2 — Not to be used when the lead angle exceeds 45°.

4.1.5 *Run out of tip diameter with reference to datum* — This shall not exceed the appropriate value for IT7 in IS : 919 (Part 1)-1963 'Recommendations for limits and fits for engineering: Part 1 General engineering (*first revision*)', for any class of worm gear.

4.2 *Worm Wheels*

4.2.1 *Circular pitch error* — The error in circumferential spacing of the teeth at the pitch circle in any one transverse plane of a wormheel shall not exceed the following:

Class	*Tolerance in Micrometres*
A	$3 + \sqrt{pc}$
B	$6 + 2{\cdot}5\sqrt{pc}$
C	$16 + 6{\cdot}5\sqrt{pc}$
D	$41 + 16\sqrt{pc}$

where

pc = length of arc of reference circle in mm over which measurements are made. This should not exceed one half the circumference.

4.2.2 *Eccentricity of wormwheel as measured by 'run out' with ball check* — The maximum 'run out' that is the full range of indicator needle movement recorded by the ball check, shall not exceed the values given below:

Class	*Centre Distance*	*Permissible Run Out, in Micrometres*
A	Less than 150 mm	25
	150 mm and above	50
B	Less than 150 mm	50
	150 mm and above	75
C	Less than 150 mm	75
	150 mm and above	100
D	Less than 150 mm	100
	150 mm and above	150

5. Normal Backlash — In order to allow for expansion of the wormwheel at working temperature, backlash must be present at the workshop temperature. Allowable backlash values are given below (based on a temperature of 20°C) which may be achieved by adjusting the wormwheel thickness:

Grade	*Minimum Micrometres*	*Maximum Micrometres*
1	$0{\cdot}25\ m\ (z_2 + 7) + 13$	$0{\cdot}25\ m\ (z_2 + 20) + 50$
2	$0{\cdot}25\ m\ (z_2 + 7) + 13$	$0{\cdot}25\ m\ (z_2 + 40) + 50$
3	$0{\cdot}25\ m\ (z_2 + 15) + 25$	$0{\cdot}25\ m\ (z_2 + 50) + 65$
4	$0{\cdot}25\ m\ (z_2 + 15) + 40$	$0{\cdot}25\ m\ (z_2 + 65) + 100$
5	$0{\cdot}25\ m\ (z_2 + 15) + 40$	$0{\cdot}25\ m\ (z_2 + 80) + 150$

Any of the grades may be associated with any class of gear at the discretion of the designer. The following suggestions are given by way of example:

Grade 1 would be suitable when backlash tolerance relate to critical requirements, such as timing gears and some control mechanisms.

Grade 2 is applicable to precision drives of machine tools.

Grade 3 is suitable for industrial applications.

Grade 4 for axle transmission gears.

Grade 5 for applications where working temperatures are of the order of 120°C.

Note — For a worm meshing with a bronze wheel in a cast iron or steel case the backlash between worm and wheel is reduced by approximately $= 0{\cdot}0035\ m\ (z_2 + 7)\ (t_u - 20)$ micrometres.

where

m = axial module of threads in mm,

z_2 = no. of teeth of wheel, and

t_u = working temperature which is above 20°C.

EXPLANATORY NOTE

In preparation of this standard considerable assistance has been derived from BS : 721-1963 'Specification for worm gearing' issued by the British Standards Institution.

Printed at Arcee Press, New Delhi, India